The end of the Hadean: a global revolution

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A U-Pb/Hf-isotope study of >16,000 zircons shows that ≥70% of Earth’s continental crust probably formed in Archean time, and much probably is >3 Ga old. The model ages (TMA) of ca 500 low-Re/Os sulfides in mantle-derived peridotite xenoliths, mainly from the Kaapvaal, Siberian and Slave cratons, peak between 2.5–3.0 or 3.0–3.5 Ga, depending on locality. At each locality the oldest TMA of mantle sulfides correlate well with the oldest U-Pb ages and Hf model ages of crustal zircons. Younger TMA peaks commonly coincide with later major crustal events.

Sulfides in mantle xenoliths are secondary phases, and Os model ages probably are biased toward young ages. Most of the studied sulfides are from garnet-bearing peridotites, and the garnet is generally a secondary phase. In Siberian xenoliths, TMA of sulfides included in garnet are younger on average than those of sulfides included in olivine. However, detailed searches of the most depleted peridotites have revealed very few sulfides with TMA >3.5 Ga, just as the oldest widespread crustal ages are around 3.5 Ga.

These data suggest that the oldest crust and the oldest, highly depleted SCLM are broadly coeval, and are interpreted as forming during massive mantle overturns that produced the residual Archean SCLM, providing buoyant “life rafts” that since have supported and preserved the continental crust. The 3.5 Ga overturn event changed Earth’s fundamental tectonic behaviour, and truly marks the end of the Hadean period.